PATENT SPECIFICATION

813,522

Date of Application and filing Complete Specification: May 16, 1957. No. 15595/57.

Application made in United States of America on May 18, 1956.

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International Classification:—F02f.

COMPLETE SPECIFICATION

Rotor Assemblies for Gas Turbine Engines

SPECIFICATION NO. 813,522

By a direction given under Section 17(1) of the Patents Act 1949 this application proceeded in the name of Canadian Patents and Development, Limited, of National Research Building, Sussex Street, City of Ottawa, County of Carleton, Province of Ontario, Canada, a Canadian company.

THE PATENT OFFICE,
2nd July, 1959

DB 11814/1(13)/3783 150 6/59 R

easily lend themselves to machining operations, are used.

It is an object of the present invention to obviate these and other disadvantages and to provide a rotor assembly that is cheaply and easily assembled and has a high resistance to centrifugal stress.

It is a further object of the invention to provide a rotor assembly in which rotor blades may be mounted without the need for prior machining of the blade roots.

It is another object of the invention to provide in the rotor assembly means for cooling the rotor disc as well as the blades when the rotor assembly is rotated.

According to the invention, the rotor assembly comprises a rotor disc having a threaded cylindrical face, a blade ring having a threaded cylindrical face mating with the threaded face of the rotor disc, the blade ring having slots in its threaded face to receive a plurality of radially projecting rotor blades, the rotor disc when assembled overlying each of the slots in the blade ring to close the slots against movement of the

[*Price 3/6*]

Fig. 1 is an exploded view of a rotor assembly for a gas turbine engine constructed according to the invention, also showing an assembling or dismantling tool, with a part of the assembly cut off to show an assembling ring on the inside of the blade ring; and

Fig. 2 is a perspective view of a segment of a slightly modified form of rotor assembly according to the invention showing a rotor disc and a blade ring in assembled position, and a cranking tool for use in assembling and dismantling the rotor assembly.

Referring to the drawings, a rotor disc 10 has an externally threaded cylindrical flange 80 11 mated to the internally threaded flange 13 of a blade ring 12. The screw threads may either extend over the entire length of the circumferential surfaces of the flange or may be interrupted according to known threading 85 practice. The hand of the thread is preferably opposite to the intended direction of rotation of the assembly or element.

The flange 13 of the blade ring has a plurality of blade slots 14 extending through 90

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Rotor Assemblies for Gas Turbine Engines

I, JOHN DAVID ALEXANDER MACKAY, of Orenda Engines Limited, Village of Malton, County of Peel, Province of Ontario, Canada, a Canadian citizen, do hereby declare the invention, for which I pray that a Patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to rotor assemblies for gas turbine engines.

In order to mount rotor blades in rotor blade discs, it is conventional to broach slots in the discs and to insert the blade roots of the blades in the slots. Such practice tends to lower the resistance of the disc to centrifugal stress. Moreover, blade roots must be machined in order to fit accurately in the slots. This greatly increases the cost of assembling the blade discs, especially when blades of plastic material or fibre-glass, which do not easily lend themselves to machining operations, are used.

It is an object of the present invention to obviate these and other disadvantages and to provide a rotor assembly that is cheaply and easily assembled and has a high resistance to centrifugal stress.

It is a further object of the invention to provide a rotor assembly in which rotor blades may be mounted without the need for prior machining of the blade roots.

It is another object of the invention to provide in the rotor assembly means for cooling the rotor disc as well as the blades when the rotor assembly is rotated.

According to the invention, the rotor assembly comprises a rotor disc having a threaded cylindrical face, a blade ring having a threaded cylindrical face mating with the threaded face of the rotor disc, the blade ring having slots in its threaded face to receive a plurality of radially projecting rotor blades, the rotor disc when assembled overlying each of the slots in the blade ring to close the slots against movement of the blades toward the rotor disc, and means for rotating one of the threaded faces relatively to the other.

According to a preferred embodiment of the invention, the rotor assembly comprises a rotor disc having an externally threaded cylindrical flange, a blade ring having an internally threaded flange slotted to receive a plurality of rotor blades and adapted to mate with the threaded flange of the rotor disc, the rotor disc overlying each of the slots in the blade ring to engage the blades and thus hold them in the slots.

The invention will now be described in more detail with reference to the accompanying drawings, it being understood that these are illustrative only and not intended to limit the scope of the invention.

In the drawings, in which each reference character denotes the same part in all the views;

Fig. 1 is an exploded view of a rotor assembly for a gas turbine engine constructed according to the invention, also showing an assembling or dismantling tool, with a part of the assembly cut off to show an assembling ring on the inside of the blade ring; and

Fig. 2 is a perspective view of a segment of a slightly modified form of rotor assembly according to the invention showing a rotor disc and a blade ring in assembled position, and a cranking tool for use in assembling and dismantling the rotor assembly.

Referring to the drawings, a rotor disc 10 has an externally threaded cylindrical flange 11 mated to the internally threaded flange 13 of a blade ring 12. The screw threads may either extend over the entire length of the circumferential surfaces of the flange or may be interrupted according to known threading practice. The hand of the thread is preferably opposite to the intended direction of rotation of the assembly or element.

The flange 13 of the blade ring has a plurality of blade slots 14 extending through its radial thickness, the slots being elongated in the axial direction of the rotor disc, as best shown in Fig. 2, and preferably they are tapered radially outwardly so that they have a lesser area on the outer than on the inner circumferential face of the flange.

Thus the slots are adapted to receive blades 15 preferably having tapered roots 15*a*, as shown in Fig. 2, that can be inserted from inside the flange of the blade ring and that are retained by the taper in the slots against removal by movement through the slots in an outward radial direction.

Instead of being tapered, the slots and blade-roots may be otherwise shaped to provide other means for preventing removal of the blades by outward movement through the slots; for instance, the slots may be stepped inwardly near the outer face of the ring, and the roots correspondingly shaped to engage the step in the slot.

The form of the invention shown in Fig. 2 has a circumferential groove 17 formed in the outer face of the flange 11 of the rotor disc, and each of the blades 15 has an open passageway extending between its outer end and the inner face of the blade root. A circumferential row of the blades is radially disposed in the slots 14. When the blades are in position, the passageways in the blades are in communication with the groove 17 in the rotor disc. Passages 18 extending through the side face of the blade ring 12 lead into the groove to receive cooling air which may be supplied by known structures to the space adjacent the rotor disc. The air entering the groove passes out through the passageways in the blades.

For convenience, removable means are provided to hold the blades temporarily in the blade ring while the ring is assembled on the rotor disc; such means may comprise an assembling ring 19 as shown in Fig. 1, preferably of spring wire, adapted to be reduced in diameter and passed under the blade roots and allowed to expand against the inner circumference of the blade ring to engage the roots and maintain them in position while the ring is secured to or removed from the rotor disc.

Also for convenience, means are provided for applying a force to the blade ring to screw it onto the rotor disc. As shown in Fig. 1, a special tool 20 provides lugs 20*a* arranged so as to enter slots 21 in the side face of the blade ring; a handle 21*b* on the tool provides sufficient leverage for tightening the blade ring on the rotor disc.

A more convenient means for tightening the elements of the assembly together is shown in Fig. 2; the rim of the blade ring 12 is provided with an inner circumferential shoulder presenting a ring of teeth 23 which mesh with teeth 25 on a cranking tool 26. The cranking tool has a shaft forming on one side a handle 27 and on the other side an axle that may be inserted in a bearing hole 28 in the face of the rotor. Rotation of the cranking tool causes rotation of the blade ring on the rotor disc until it is tightened or loosened.

When assembling the rotor assembly or element by threading the flanges together, advantage may be taken of the working temperature difference between them, by arranging that the internally threaded flange of the cooler part (the ring) overlaps on the outside the externally threaded flange of the hotter part, (the rotor disc) thereby ensuring that any differential expansion will tend to keep the threaded joint tight.

The foregoing description sets forth the best mode contemplated by the inventor of carrying out his invention, but the following Claims are intended to cover all useful changes and modifications of the said mode which are within the scope of the invention.

WHAT I CLAIM IS:—

1. A rotor assembly for a gas turbine engine comprising a rotor disc having a threaded cylindrical face, a blade ring having a threaded cylindrical face mating with the threaded face of the rotor disc, the blade ring having slots in its threaded face to receive a plurality of radially projecting rotor blades, the rotor disc when assembled overlying each of the slots in the blade ring to close the slots against movement of the blades toward the rotor disc, and means for rotating one of the threaded faces relatively to the other.

2. A rotor assembly as claimed in Claim 1 in which the threaded face of the rotor disc is on an externally threaded cylindrical flange and the blade ring has an internally threaded flange mating with the flange of the rotor disc.

3. A rotor assembly as claimed in Claim 1 or 2 including means for preventing movement of the blades away from the rotor disc.

4. A rotor assembly as claimed in Claim 3 in which the means for preventing movement of the blades away from the rotor disc comprises tapered walls of the slots and correspondingly tapered roots on the blades whereby the blades can be removed from the slots only by radially inward movement.

5. A rotor assembly as claimed in any of the preceding Claims in which the means for rotating one of the threaded faces relatively to the other comprises a tool having lugs engageable with slots in the blade ring and having a handle for turning the tool and with it the blade ring.

6. A rotor assembly as claimed in any of the preceding Claims 1 to 4 in which the blade ring has a ring of radially projecting gear teeth and including a cranking tool having gear teeth adapted to mesh with the teeth on the blade ring and having a shaft

providing a handle and an axle, the rotor disc having a bearing hole for the axle of the tool disposed so that the teeth on the tool and the ring are in operative engagement whereby rotation of the handle rotates the blade ring.

7. A rotor assembly as claimed in any of the preceding Claims in which the threaded face of the rotor disc or of the blade ring has a circumferential groove communicating when the blade ring is threaded on the rotor disc with the exterior of the assembly, and in which each of the rotor blades has a passage extending from an opening at the tip of the blade to an opening at the radially inner end of the blade communicating with the groove whereby cooling air entering the groove will pass out through the passageways in the blades.

8. A rotor assembly as claimed in any of the preceding Claims including an expansible elastic annular element having a diameter normally greater than the inner diameter of the blade ring and adapted to expand against the said inner diameter to overlie at least part of each of the slots in the blade ring to lock the blades in the slots while the blade ring is being mated with the rotor disc.

9. A rotor assembly as claimed in Claim 8 in which the expansible element is a ring of elastic wire.

10. A rotor assembly constructed and arranged to operate substantially as described with reference to Fig. 1 of the accompanying drawings.

11. A rotor assembly constructed and arranged to operate substantially as described with reference to Fig. 2 of the accompanying drawings.

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813522 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

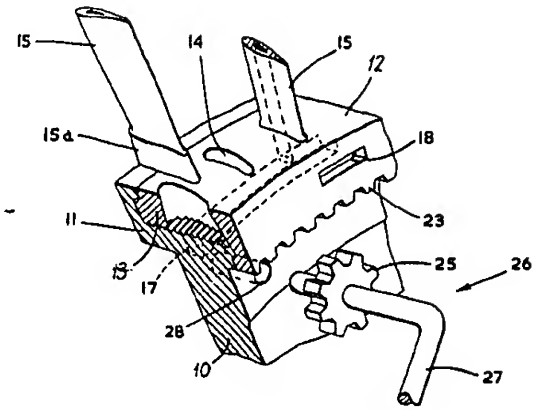

FIG. 2

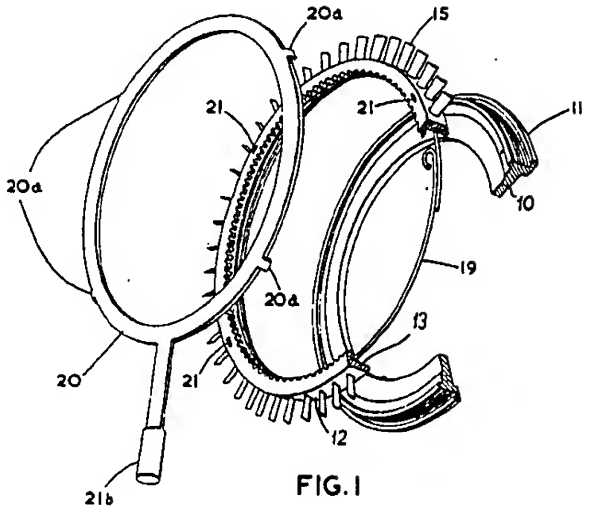

FIG. 1